QUIZ #2 Dr. Ebrahim A.Rahman

Sec. 1 Nov. 23rd 2014

Name _____ **STD-ID** _____

The following formulae may be needed in the questions:

1. **Bitrate** $= 2 \times B \times log_2 L.$
2. **C** $= B \times log_2 (1 + SNR).$
3. **dB** $= 10 \times log_{10} \frac{P2}{P1}.$

Q1. Read the questions carefully and select the best answer.

1) The ---------- is the maximum number of bits that the link can contain in the same time.

- ☐ a. Bandwidth.
- ☐ b. Throughput.
- ☐ c. Latency.
- ☐ d. Bandwidth-Product.
- ■ e. Bandwidth-Delay Product.
- ☐ f. Jitter.

2) The ---------- is a type of transmission impairment in which the signal loses strength due to the resistance of the transmission medium.

- ■ a. Attenuation.
- ☐ b. Noise.
- ☐ c. Cross Talk.
- ☐ d. Coupling.
- ☐ e. Distortion.
- ☐ f. Decibel.

3) For a ---------- channel, the Nyquist bit rate formula defines the theoretical maximum bit rate.

- ☐ a. Noisy.
- ■ b. Noiseless.
- ☐ c. Both a and b.
- ☐ d. None of the above.

4) The power of a signal is 0.1 *W* and the power of the noise is 0.1 *mW*. The value of SNR_{dB} is

- ☐ a. 10.
- ☐ b. 20.
- ■ c. 30.
- ☐ d. 40.
- ☐ e. 50.
- ☐ f. 1000.

Q2. Fill the blank with suitable words/numbers.

1) The performance of a telephone line is 4 kHz. When the signal is 20.47 V, the noise is 10 mV. The maximum data rate supported by this telephone is ----------**----** kbps.

Sol:

$$SNR = \frac{20.47 \times 1000}{10} = 2047$$

$$C = B \times log_2 (1 + SNR)$$

$$= 4000 \times log_2 2048$$

$$= 4000 \times 11 = 44000 \text{ bps}$$

$$= 44 \text{ kbps}$$

2) A noiseless channel with a bandwidth of 3000 Hz is transmitting a signal with four signal levels. The maximum bit rate this channel can achieve is ---------- kbps.

Sol:

$$\text{BitRate} = 2 \times \text{Bandwidth} \times log_2 L$$
$$= 2 \times 3000 \times log_2 4$$
$$= 12000 \text{ bps}$$
$$= 12 \text{ kbps}$$

3) -------- **Digital-**-------- data have discrete states and take discrete values.

Q3. The attenuation of a signal is -10 dB. What is the final signal power if it was originally 5 W?

Sol:

$$-10\text{dB} = 10 \times log_{10} \frac{P2}{P1}$$

$$\rightarrow \frac{P2}{P1} = 10^{-10/10}$$

$$\frac{P2}{5} = 10^{-1}$$

$$\rightarrow P2 = 5 \times 10^{-1}$$

$$= 0.5 \text{ W}$$

Q4. Consider the following network path with 2 routers. The speed (bandwidth) and delay (propagation delay) of the link are as indicated in the figure. Assume that the path is completely empty initially.

i. **What is the total time required to transmit a 500 kB packet across this path? [assuming that the processing delay is zero]**

Sol:

$$\text{Transmission time} = \frac{\text{Data Sixe}}{\text{Bandwidth}} = \frac{500 \times 1024 \times 8}{20 \times 1000 \times 1000 \times 1000} = 204.8 \text{ µs}$$

Total Time = Transmission time + Propagation time + Queuing time + Processing time

= 204.8 + 4000 + 0 + 0 = 4204.8 µs

ii. What is the maximum number of bits of data that this network path carries at any moment?

Sol:

Propagation delay = 4000 µs = 4000 $\times 10^{-3}$ ms = 4000 $\times 10^{-6}$ s

Bandwidth = 20 Gbps = 20 $\times 10^{3}$ Mbps = 20 $\times 10^{6}$ kbps = 20 $\times 10^{9}$ bps

Bandwidth-Delay Product = propagation delay × bandwidth

$$= 4000 \times 10^{-6} \times 20 \times 10^{9} = 8 \times 10^{7} \text{ bits}$$

$$= 10^{7} \text{ Bytes}$$

iii. A MP3 file is roughly 4MB. How many MP3 files can the path carry at any moment.

Sol:

$$\text{Total MP3 files} = \frac{\text{Bandwidth} - \text{delay product}}{\text{Size of MP3 file}}$$

$$= \frac{10^{7}}{4 \times 1024 \times 1024} \cong 2.38 \text{ MP3 files.}$$